

Chapter 1

Neonatal Monitoring: Current Practice and Future Trends

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ABSTRACT

This chapter describes the current practice of monitoring vital health parameters in critically ill newborn infants in neonatal intensive care units (NICU). These infants are extremely tiny and vulnerable, so that special requirements are needed. After the first decades following the start of modern neonatology the focus shifted from management to keep the baby alive to strategies to improve the quality of life. In this respect monitoring of brain function became important. In addition there is gradually growing awareness that procedural pain, discomfort and excessive sensory stimuli are detrimental for the developing preterm infants. Therefore, the authors describe non-obtrusive monitoring technologies that meet their specific demands. The authors describe how neonatal monitoring has become a multidisciplinary area which involves a unique integration of knowledge from medical science, design, technology and social study.

INTRODUCTION

Neonatology is a subspecialty of pediatrics that started to develop in the 1940s. After the World War II the specific needs of sick newborn infants were recognized and new premature nurseries were built (Avery, 1998). At that time the overall neonatal mortality of infants with a birth weight

below 1800 g in the United States was 50%. The term “Neonatology” was first used by Alexander Schaffer in 1960 in the introduction of the first edition of his book (Philip, 2005; Schaffer, 1960). The miniaturization of samples for blood tests, needed for clinical management including electrolytes, bilirubin and blood gases was one of the major advances in the development of Neonatology. In the following decades important progress was achieved in thermoregulation, nutrition, growth,

DOI: 10.4018/978-1-4666-0975-4.ch001

Figure 1. Care of mother and child in 1965



respiratory support, cardiopulmonary support and infection control (Philip, 2005).

In the Netherlands treatment of high risk neonates is restricted by law to 8 academic and 2 non-academic Neonatal Intensive Care Units (NICU's). In the year 2008 the total number of admissions in the NICU's was 4.461 and the average of admission time was 15 days. These numbers could be realized since the total number of NICU beds was 212 (Netherlands Perinatal Registry, 2011). The total annual costs for neonatal intensive care in the Netherlands comprise 110 million Euros.

Neonatal monitoring refers to monitor vital physiological parameters of neonates. Monitoring of the newborn is an old biological phenomenon. All species of the animal kingdom monitor their offspring from birth, using the sense organs for smelling, tasting, feeling, seeing and hearing (Cone, 1980). Critically ill neonates are a special group of patients that consists of premature infants and full term infants that became severely ill during or immediately after birth. Premature infants are babies that are born after a pregnancy lasting 37 weeks or less. Critically ill preterm neonates can weigh as little as 500 g with a size

of our palm and are highly vulnerable to external disturbances. Premature neonates are normally admitted to neonatal incubators in Neonatal Intensive Care Units (NICU's). Neonatal medicine has progressed strongly in the past decades (Figures 1, 2, and 3). Continuous health monitoring for the neonates provides crucial parameters for urgent diagnoses so that adequate medical treatment can be instituted. Recent advances over the last decades in medical treatments resulted in a significant increase of survival (Figure 4). As a result, neonates born after 25 weeks of pregnancy can survive with appropriate medical care in the NICU (Costeloe, Hennessy, Gibson, Marlow, & Wilkinson, 2000). Therefore, incubators are populated by steadily younger neonates, whose survival and long-term health prospects depend strongly on reliable and comfortable health-status monitoring systems.

During neonatal intensive care, continuous monitoring of the neonates is a tool that provides early indication on the changes in vital functions of the patient (Murković, Steinberg, & Murković, 2003), and thus crucial for early detection of inadvertent events (cessation of breathing, heart

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